REMARKS

The original PCT claims have been reformatted, solely to conform to US formal standards; no change in scope is intended. In order to avoid PTO surcharges and formal objections, multiple dependencies have been eliminated and corresponding single-dependent claims 10-26 have been added. Main method claim 27 corresponds to former claim 7 and dependent method claim 28 corresponds to former claim 8.

In view of the replacement of "past-passive" verbs in the claims with "active" verbs, a corresponding change has been made in the Abstract.

The specification has been amended to comply with US rules concerning reference to the PCT phase and concerning customary section headings.

If the Office detects any other informalities which would hinder or prevent examination on the merits, a telephone call to the undersigned is requested, for prompt resolution thereof.

The filing fee is enclosed; no *other* fee is believed required; if any <u>is</u> required, it may be charged to Deposit Account No. 23-0442.

Respectfully submitted,

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EXTERNAL-ROTOR MOTOR AND METHOD FOR ASSEMBLING SUCH A MOTOR

CROSS-REFERENCE

This application is a § 371 of PCT/EP03/010139, filed 12 SEP. 2003 and published 10 JUN. 2004 as WO 2004/048791-A1. The application claims priority from DE 102 54 949.4, filed 26 NOV. 2002, the entire disclosure of which is incorporated by reference.

FIELD OF THE INVENTION:

The invention concerns an external-rotor motor, and it concerns a method for assembling an external-rotor motor.

BACKGROUND:

In many external-rotor motors, the shaft of the external rotor is supported in a so-called bearing support tube on whose outer side a stator lamination stack is mounted. The shaft is usually mounted on the hub of a so-called rotor cup, and is supported within the bearing support tube by means of bearings, e.g. sintered bearings or rolling bearings. The type of bearing system depends principally on the desired service life of the motor and the desired smoothness.

For installation of the shaft, the bearing support tube usually has, on its side facing away from the rotor cup, an opening where components are located that serve to retain or support the shaft, e.g. a thrust bearing, spring member, retaining washer, bearing cover, or the like. Dirt can penetrate through this opening and shorten the service life of such a motor. Time is also needed for assembly, making such motors more expensive.

SUMMARY OF THE INVENTION:

It is therefore an object of the invention to make available a novel external-rotor motor, and a new method for assembling such a motor.

According to a first aspect of the invention, this object is achieved by means of an external-rotor motor ~~according to claim 1.~~ in which a compression spring, a retaining washer, and a pair of rolling bearings are pre-

mounted on the shaft of the rotor, and assembly can be completed by simply sliding the rotor assembly into a bearing support tube in the stator assembly, the lip of the retaining washer serving as a pawl to latch the structure together.
In such a motor, the bearing support tube can be largely closed, so that dirt cannot penetrate there.
It is also inexpensive to install.

According to another aspect of the invention, this object is achieved by ~~means of the subject matter of claim 7.~~ applying compression force to the rotor assembly to compress the spring and to drive the bearings and retaining washer into the bearing support tube, then removing the pressure, thereby allowing the spring to clamp the rolling bearings in place, relative to the rotor shaft. Assembly in this fashion requires only a small number of working steps and can be largely or even completely automated. An advantageous refinement of this method is ~~the subject matter of claim 8.~~ to provide an annular axial projection on the rotor cup, surrounding the spring, to transfer the pressing force to an outer ring of the nearest rolling bearing. The risk of damage to the rolling bearings upon installation is thus reduced.

BRIEF FIGURE DESCRIPTION:

Further details and advantageous refinements of the invention are evident from the exemplary embodiment, in no way to be understood as a limitation of the invention, that is described below and depicted in the drawings.

~~, and from the dependent claims. In the drawings:~~

FIG. 1 depicts, in longitudinal section, the essential parts of the external rotor of an external-rotor motor;

FIG. 2 is a depiction analogous to FIG. 1 in which, however, various elements for a subsequent installation operation are pre-installed on the shaft of the external rotor;

FIG. 3 is a longitudinal section through a bearing support tube provided on the stator of the motor, viewed along line III-III of FIG. 4;

FIG. 4 is a plan view of the open, proximal end of the bearing support tube, viewed in the direction of arrow IV of FIG. 3;

FIG. 5 is a depiction analogous to FIG. 4 in which, however, a circuit board and a stator lamination stack provided with a stator winding are pre-installed on the bearing support tube;

FIG. 6 is a schematic depiction showing a snapshot during the "marriage" of stator and rotor;

FIG. 7 is a longitudinal section through an assembled motor that can be used, for example, to drive an equipment fan;

FIG. 8 is a section through a so-called retaining washer, viewed along line VIII-VIII of FIG. 9; and

FIG. 9 is a plan view of the retaining washer, viewed in the direction of arrow IX of FIG. 8.

DETAILED DESCRIPTION:

FIG. 1 shows an external rotor 22 for an external-rotor motor 20 as depicted in FIG. 7. External rotor 22 has a rotor cup 24 that is usually manufactured from plastic or a lightweight metal.

The parts that are facing toward rotor cup 24 will be referred to hereinafter, by analogy with medical terminology, as "proximal," and the parts facing away from rotor cup 24 as "distal."

Mounted in the center of rotor cup 24, i.e. on its hub 36, is proximal end 26 of a shaft 28 at the distal end of which is provided an annular groove 30 that serves, as shown in FIG. 2, for mounting of a snap ring 32. The distal end of shaft 28 is labeled 34. Shaft 28 has a cylindrical cross section, and its diameter is constant over practically the entire length. Located on hub 36 is an axial projection 38 that protrudes in the distal direction away from hub 36 and has a depressed region 39 in its center.

A magnetic yoke in the form of a sheet-metal ring 40 made of soft iron is mounted in rotor cup 22, and on the ring's inner side is located a (usually flexible) ring 44 made of permanent-magnetic material, usually a so-called rubber magnet, i.e. a mixture of ferromagnetic particles and an elastomer. Ring 44 is magnetized in the radial direction with the requisite number of magnetic poles, e.g. with four poles as is common practice in the art.

As shown in FIG. 2, a variety of components are pre-installed on shaft 28 prior to the assembly of motor 20.

Beginning at projection 38, the first is a compression spring 48 of approximately conical shape whose proximal, larger-diameter end lies in depression 39.

Following spring 48 in the distal direction is an annular retaining member in the form of a retaining washer 50,

ABSTRACT

~~The invention concerns a method for installing~~ A method of rapidly assembling the rotor (22) of an external-rotor motor (20) onto a bearing support tube (70) and in a predetermined axial position relative to the latter, which rotor (22) comprises a rotor cup (24) and a rotor shaft (28), ~~the method comprising~~ includes the following steps:

a) beginning at the rotor cup (24), pre-mounting, onto the rotor shaft (28), a compression spring (48), a retaining washer (50), and a bearing arrangement having a plurality of rolling bearings (52, 60) ~~are mounted on the rotor shaft (28)~~, the inner rings (56, 64) of the rolling bearings being slidingly displaceable on the rotor shaft (28) within a predetermined region;

b) pressing the rotor (24), with the elements mounted thereon, ~~is pressed~~ into the bearing support tube (70) by means of a pressing-in force (K), the compression spring (48) being compressed so that the rotor cup presses the retaining washer (50) into the bearing support tube (70); and

c) removing the pressing-in force (K) ~~is removed, and~~ so that the rotor shaft (28) is displaced by means of the compression spring (48) within the inner rings (56, 64) of the bearings (52, 60) in such a way that the rotor (24) assumes the predetermined axial position relative to the bearing support tube (70). The method is advantageous because the steps are simple enough to be automated, and the structure is advantageous because the closed bearing tube prevents dirt and contaminants from getting into the bearings, thereby extending service life.